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(54) Title: <b>PORTABLE RADIO BATTERY PACK WITH ON-OFF SWITCH</b>			
(57) Abstract			
<p>An improved arrangement for powering a two-way portable radio or the like comprises rechargeable battery cells and sets of power input and output contacts interconnected to each other and the battery cells in such a way that the output contacts may be electrically connected to the battery cells for powering the radio, or to the input contacts for receiving power directly from a battery charger for dead battery operation while simultaneously recharging the battery cells, all battery pack contacts being electrically isolated from the battery cells in the latter mode of operation.</p>			

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## PORTABLE RADIO BATTERY PACK WITH ON-OFF SWITCH

### Background of the Invention

The present invention relates to batteries and, more particularly, to rechargeable battery packs for use with portable two-way radios.

5       Portable two-way radios and similar devices are typically powered by rechargeable batteries, such as nickel-cadmium battery cells packaged in a battery pack which is easily removable from the radio for recharging in a battery charger. The size of the  
10      battery pack and the number of cells vary, depending on the power and operational life of the battery required between chargings.

15      It is necessary on portable radios that means be provided for switching off battery power when the radio is not used in order to conserve battery life. It is also desirable to be able to operate the radio in a battery charger circuit, even if the battery is dead or defective, as a back-up mode of operation. Thus, an uncharged or defective battery should not  
20      cause loss of communications as long as a battery

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charger is available. This is referred to as dead battery operation. It is also desirable to be able to electrically isolate the battery terminals when the battery pack is being disconnected from the radio  
5 to prevent arcing. This is particularly desirable in the presence of explosive gases which could be ignited by such arcing.

Prior art radios confine the on-off switch to the radio body itself. This location requires that  
10 an electrical conductor be routed from the radio's battery contacts to the switch, and thereafter to a radio systems connection and/or distribution point. Generally, the size of the electrical conductor is relatively large in order to keep the electrical  
15 losses to a minimum. This presents several problems in a portable hand-held radio. First, a large electrical conductor takes up substantial space in an already crowded portable radio. Second, routing the electrical conductor through the systems portion of  
20 the radio usually results in a loss of accessibility to electrical components also located in that area.

Dead battery operation in prior art radios has been provided by means of switching contacts in the radio or isolation diodes in the battery, radio or  
25 charger circuits. These components add complexity and/or expense.

Summary of the Invention

Accordingly, it is the primary object of the present invention to provide an improved arrangement  
30 for powering a portable radio in which the battery power switch is not located in the control systems portion of the radio.

It is a further object of the present invention to provide a battery pack for a portable two-way radio  
35 which can be electrically isolated from the radio

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during battery removal.

It is yet another object of the present invention to provide a battery pack arrangement for a portable two-way radio which will accommodate dead 5 battery operation.

These and other objects and advantages will be more clearly understood from the following detailed description, drawings and specific examples, all of which are intended to be typical of rather than in 10 any way limiting to the scope of the present invention.

Briefly stated, the above objectives are accomplished in one embodiment of the present invention in which the battery on-off switch is 15 located in the battery pack instead of in the radio control systems section. Two sets of contacts are provided on the battery pack - one set interconnects to the radio for providing the radio with power; the other set interconnects with a charger for recharging 20 the battery pack and for dead battery operation.

A first one of the radio contacts is internally electrically connected to the negative battery cell terminal and a first one of the charger contacts (negative). The other radio contact is connected to 25 the on-off switch. One pole of the on-off switch (the ON pole) is connected to the positive battery cell terminal and, through an isolation diode, to a second (positive) charger contact. With the switch in the OFF position, the second radio contact is 30 connected directly to another (third) positive charger contact for dead battery operation. When the battery is removed from the radio and the switch is in the OFF position, no power is available at any of the battery pack contacts since the positive 35 (second) charger contact is diode isolated, greatly

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reducing the risk of accidental battery discharge.

Brief Description of the Drawings

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as part of the present invention, it is believed that the invention will be more fully understood from the following description of the preferred embodiment which is given by way of example with the accompanying drawings in which:

Figure 1 is a frontal view of a portable two-way radio having a battery pack embodying the subject invention;

Figure 2 is a side view of the portable two-way radio of Figure 1;

Figure 3 is a perspective view of a battery pack constructed in accordance with the present invention; and

Figures 4 is a circuit diagram of the battery pack of Figure 3.

Description of the Preferred Embodiment

Referring to the drawings wherein like numerals correspond to like elements throughout, attention is first directed to Figures 1 and 2 wherein a typical portable two-way radio 10 is depicted. Such a radio comprises a radio portion 12 which contains a transmitter and receiver (transceiver) and associated electronic control equipment, and a battery pack 14 which is attached to and powers the radio portion 12. The radio portion 12 has a generally rectangular housing 16 which includes speaker and microphone portion 18, a key pad 20 for "dialing" selected other radios or telephones, an LCD display window 22 for displaying called numbers and other programmed information, a control panel 24 on the top of the

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radio having switches and/or knobs for squelch control, channel selection, volume and the like, and an antenna 26 for receiving and radiating a radio signal. Push to talk button 28 is located on the 5 side of the radio just below the section 30 containing electrical contacts which mate with a universal device connector (UDC) for accessory attachment and/or remote control of the radio. The UDC contact section 30 of the radio is the subject of 10 a copending, commonly-assigned patent application serial number \_\_\_\_\_ filed concurrently with the present application, the subject matter of which is incorporated herein by reference.

Referring to Figure 3, the battery pack 14 is 15 shown to have mounted on its side an on-off power switch 32 which controls the flow of current to a pair of output radio contacts 34, 36 on the top of the battery pack. When installed on the radio, contacts 34, 36 are brought into electrical contact 20 with mating terminals on the bottom of the radio housing 16. The internal circuitry of battery pack 14 will now be described in detail with specific reference to Figure 4.

As shown in Figure 4, the battery pack power 25 output contacts 34, 36 are connectable to mating terminals 38, 40, respectively, on radio portion 12. A second set of power input contacts 42, 44, 46 interconnects with cooperating terminals 48, 50, 52, respectively, on a battery charger 54 which converts 30 AC current from source 56 to DC current for charging battery pack 14 and for providing dead battery operation of the radio.

Contact 34 is electrically connected to contact 46 and the negative terminal of internal battery 35 cells 58, preferably of the nickel-cadmium type.

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Contact 36 is electrically connected to switch 32 having an OFF and ON position. With switch 32 in the OFF position, radio side contact 36 is electrically connected to charger side contact 42. The ON side of 5 switch 32 is electrically connected to the positive terminal of battery cells 58 and to battery side contact 44 through isolation diode 62.

For normal radio operation, contact pairs 34, 38 and 36, 40, are connected and switch 32 is placed in 10 the ON position to provide battery power to the radio portion. However, when connected to battery charger 54, power may be delivered from source 56, through switch 32 in the OFF position, to the radio circuits. Battery cells 58 may also be independently 15 charged through the (+) battery contact 50 with the radio connected to or disconnected from the battery pack 14. If the battery cells 58 are short circuited or otherwise defective, the radio 12 may still be operated if connected to the charger through the 20 battery pack with switch 32 in the OFF position.

Note that when battery pack 14 is removed from radio portion 12 with switch 32 in the OFF position, no power is available at any of the battery pack contacts 34, 36, 42, 25 44, 46 because contact 44 is diode isolated. This greatly reduces the risk of accidental arcing during battery pack removal.

In addition, it should be noted that battery power entering radio portion 12 may be routed 30 directly to a main distribution point in the most convenient manner because it is no longer necessary to provide a power control in the electronics section of radio portion 12.

The best mode contemplated for carrying out this 35 invention has been set forth in the description

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above. It should be obvious, however, to one skilled in the art that certain changes can be made to the above-described invention without departing from the broad inventive concepts thereof. It is intended  
5 that the appended claims cover such variations in the present invention's broader inventive concepts. Having thus described the invention, what is claimed and desired to be secured by Letters Patent of the United States is:

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THE CLAIMS

1. An improved battery pack for powering a radio or the like comprising:
  - a rechargeable battery cell;
  - a set of power output contacts;
- 15 a set of power input contacts;
  - means for electrically interconnecting said input and output contacts and said battery cell such that said output contacts may be alternatively interconnected to said battery cell, or to said input contacts while simultaneously electrically isolating said input and output contacts from said battery cell.
- 20 2. An improved battery pack for powering a radio or the like comprising a rechargeable battery cell and sets of input and output contacts interconnected to each other and said battery cell in such a way that said output contacts may either be electrically connected to said battery cell for powering said radio in a first operating mode, or electrically connected to said input contacts for receiving power from a battery charger for dead battery operation in a second operating mode while simultaneously recharging said battery cell, all battery pack contacts being
- 25 30 35 electrically isolated from said battery cell in said

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second operating mode.

3. Radio apparatus comprising:

a radio section; and

a battery pack removably attachable to said

5 radio section for providing power thereto through  
mating electrical contacts on said radio section and  
said battery pack, said battery pack comprising a  
battery cell, electrical circuitry interconnecting  
said battery cell with said battery pack electrical  
10 contacts, and switch means for interrupting said  
battery pack electrical circuitry to prevent battery  
cell power from reaching said battery contacts during  
removal of said battery pack from said radio section.

4. A battery pack for providing power for a

15 portable radio or the like comprising:

at least one rechargeable battery cell having  
positive and negative terminals.

a first set of first and second power output  
contacts for interconnecting to a radio or the like;

20 a second set of third, fourth and fifth power  
input contacts for interconnecting to a battery  
charger, said third contact being electrically  
connected to said first contact and said negative  
battery cell terminal; and

25 a switch alternatively electrically connecting  
said second contact to said fifth contact in an OFF  
position or to said positive battery cell terminal  
and said fourth contact through an isolation diode in  
an ON position;

30 whereby, with said switch in said ON position  
battery cell power is available at said first set of  
contacts; with said switch in said OFF position and  
said second set of contacts unconnected to said  
charger, no battery cell power is available at any of

35 said contacts; and, with said switch in said OFF

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position and said battery pack connected to said charger, said first set of contacts is powered while said battery cell may be independently recharged by said charger.

5 5. An improved rechargeable battery pack for providing power for a portable radio or the like comprising:

a rechargeable battery cell;

a first set of power output contacts for

10 interconnecting to a radio or the like;

a second set of power input contacts for interconnecting to a battery charger; and

15 means for electrically connecting said battery cell to said first set of contacts in one mode of operation and for electrically isolating said battery cell from both said first and second sets of contacts in a second mode of operation.

6. The improved battery pack of claim 5 wherein said connecting and isolating means comprises an electrical switch which, in said first mode of operation interconnects said battery cell with said first set of contacts, and in said second mode of operation electrically isolates said battery cell from said first set of contacts; and a diode which 25 electrically isolates said second set of contacts from said battery cell in said second mode of operation.

7. The improved battery pack of claim 5 wherein: said first set of power output contacts comprises 30 first and second contacts; said second set of power input contacts comprises third, fourth and fifth contacts; said battery cell has positive and negative terminals, said negative terminal being electrically connected to said first and third contacts and said 35 positive terminal being electrically connected to

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said fourth contact through said isolation diode; and  
said switch electrically interconnects said second  
contact and said positive battery cell terminal in  
said first mode of operation, and alternatively  
5      electrically interconnects said second and fifth  
contacts in said second mode of operation.

8. Apparatus for powering a portable radio or the  
like comprising:

10     a battery charger for converting AC current to  
DC current, said charger having two positive output  
terminals and one negative output terminal;

a battery pack for providing DC power for a  
portable radio or the like comprising:

15     a rechargeable battery cell;  
a first set of two power output contacts for  
interconnecting to said radio or the like;  
a second set of three power input contacts for  
interconnecting to said battery charger terminals,  
one of said second set of contacts being  
20     interconnected to one of said first set of contacts  
and said battery cell and for interconnecting to the  
negative one of said charger terminals; and

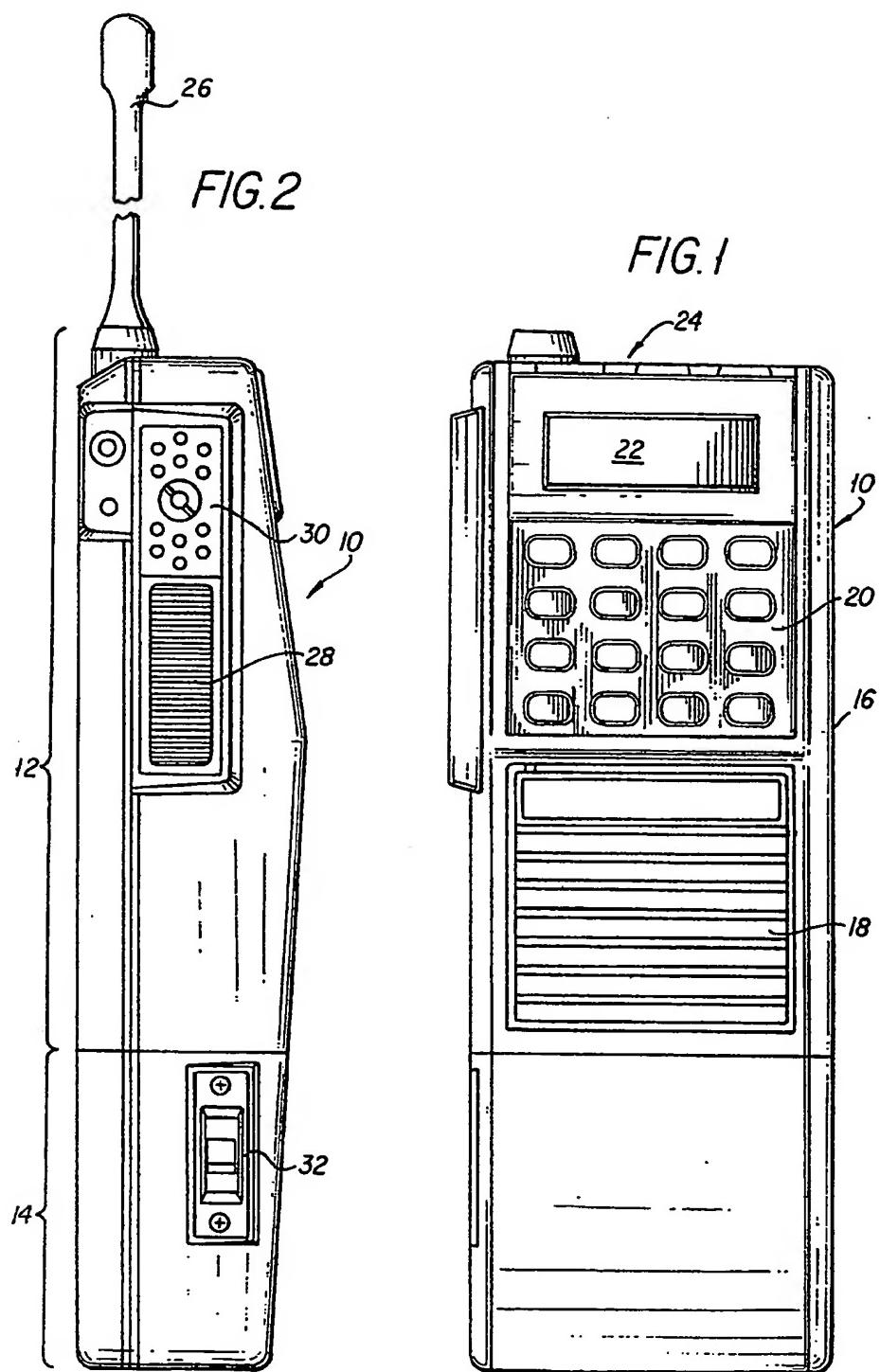
25     a switch electrically connecting, in an ON  
position, a second of said first set of contacts with  
said battery cell and, through an isolation diode, a  
second of said second set of contacts, and further  
connecting, in an OFF position, said second of said  
first set of contacts with a third of said second set  
of contacts, said second and said third contacts of  
30     said second set each being inter-  
connectable with different ones of said positive  
charger terminals;

35     whereby, with said switch in said ON position,  
battery cell power is available at said first set of  
contacts; with said switch OFF and said second set of

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contacts unconnected to said charger, no battery cell power is available at any of said contacts; and, with said switch OFF and said second set of contacts connected to said charger, dead battery operation of 5 said radio or the like is possible while independently recharging said battery cell.

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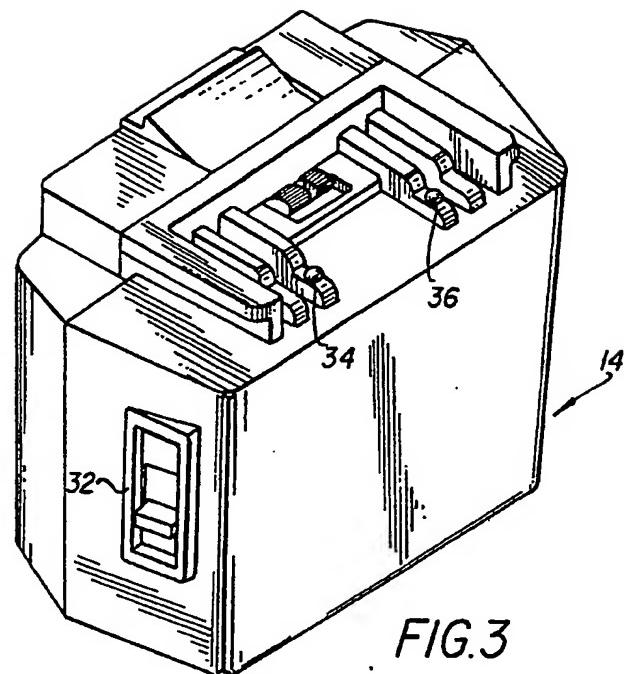


FIG. 3

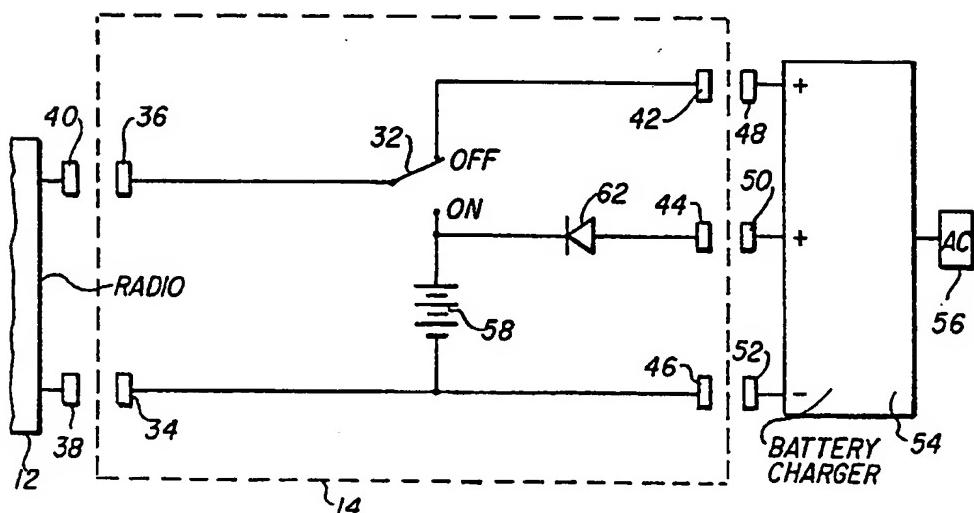


FIG. 4

# INTERNATIONAL SEARCH REPORT

International Application No PCT/US 86/02139

## L CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) <sup>6</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC

<sup>4</sup> IPC : H 04 B 1/034; H 04 B 1/38; H 02 J 7/00; H 01 M 10/46

## II. FIELDS SEARCHED

Minimum Documentation Searched <sup>7</sup>

Classification System	Classification Symbols
<sup>4</sup> IPC	H 04 B; G 08 B; H 02 J; H 01 M

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>

## III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup>

Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	GB, A, 2075247 (COAL INDUSTRY LTD) 11 November 1981, see page 1, lines 5-12, line 86 to page 2, line 108; figures 1-8	1,2,5,6
Y	--	3,4,7,8
X	Product Engineering, volume 38, no. 18, 28 August 1967, Morgan-Grampian Publishing Corp. New York (US) "Electrical/Electronic Power & Control", page 66, see the whole document	1-3,5
X	Funkschau, volume 41, no. 21, 1 November 1969, München (DE) D. Crantz: "Netzversorgung für Batterie Reiseempfänger", pages 749,750, see page 749, middle column, line 3 to page 750 end of left-hand column, figure 2	1,2,5,6
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\* Special categories of cited documents: <sup>10</sup>

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## IV. CERTIFICATION

Date of the Actual Completion of the International Search

19th January 1987

Date of Mailing of this International Search Report

19 FEB, 1987

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

M. VAN MOL

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	US, A, 3763434 (BLESCH et al.) 2 October 1973, see column 2, line 55 to column 5, line 30; figures 1-7 --	3,4,7,8
A	FR, A, 2223876 (TEXAS INSTRUMENTS) 25 October 1974, see page 3, line 8 to page 5, line 13; page 6, line 5 to page 8, line 12; figures 1-3 --	1-3
A	EP, A, 0018940 (AUTOPHON AG) 12 November 1980, see page 3, line 21 to page 4, line 7; figures 1-3	3
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/US 86/02139 (SA 14957)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/02/87

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 2075247	11/11/81	None	
US-A- 3763434	02/10/73	DE-A, B, C 2309045 FR-A, B 2174279 AU-A- 5216173 GB-A- 1402486 AU-B- 466700 CA-A- 1025949 JP-A- 48100631	20/09/73 12/10/73 15/08/74 06/08/75 06/11/75 07/02/78 19/12/73
FR-A- 2223876	25/10/74	NL-A- 7316345 BE-A- 808242 DE-A- 2362243 AU-A- 6265173 GB-A- 1456229 CA-A- 998736 JP-A- 50010022	02/10/74 29/03/74 10/10/74 22/05/75 24/11/76 19/10/76 01/02/75
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For more details about this annex :  
see Official Journal of the European Patent Office, No. 12/82